

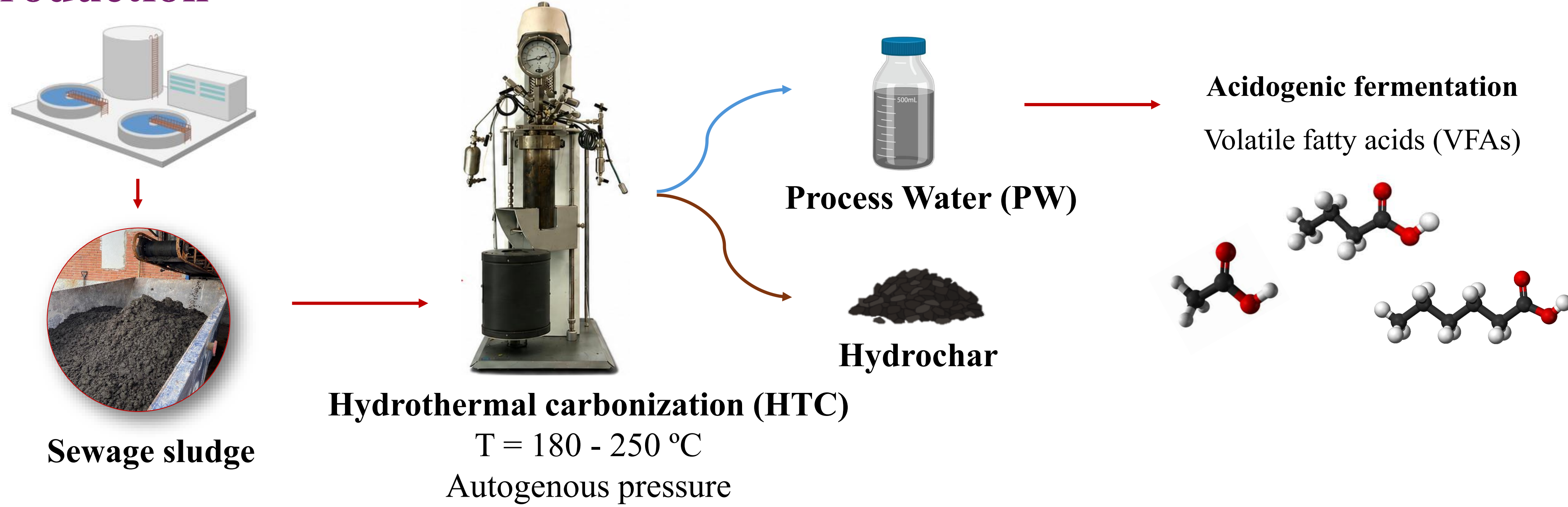
From Sewage Sludge to High-Value VFAs: Acidogenic Fermentation with Ethanol, Lactic Acid and Food Industry Residues

L. Martinez-Sanchez^{1*}, G. Langa¹, C. Diaz-Padilla¹, M. Tobajas^{1,2}, E. Diaz^{1,2}, A.F. Mohedano^{1,2}, M.A. de la Rubia^{1,2}

¹Department of Chemical Engineering, Universidad Autonoma de Madrid, 28049 Madrid, Spain

²Institute for Advanced Research in Chemistry, Universidad Autonoma de Madrid, 28049 Madrid, Spain

Introduction



Objectives

- ✓ To evaluate VFA production and composition through acidogenic fermentation, using **PW from sewage sludge** as a substrate.
- ✓ To investigate chain elongation through the addition of electron donors such as **ethanol, lactic acid, and agro-industrial wastes** (wine lees and cheese whey).

Materials & Methods



Batch tests:

Test 1: Effect of pH (5.5, 7.6, 9.0) and solid content (Filtrated PW 0.5 mm or 0.45 µm)

Test 2: VFAs chain elongation using **ethanol** and **lactic acid** (5, 10, 15 g/L)

Test 3: VFAs chain elongation using **wine lees** and **cheese whey** as co-substrates

Substrate: PW from sewage sludge (HTC: 230 °C, 45 min)

Inoculum: Thermally pretreated (105 °C; 1 h), volatile solids = 6.5 g/kg

SIR = 2 (COD basis)

Analysis:

Evolution of solids, soluble and total COD, pH, ethanol and VFA content (GC-FID), lactic acid and lactose concentration (HPLC).

Results & Discussion

Test 1: Optimum pH selection

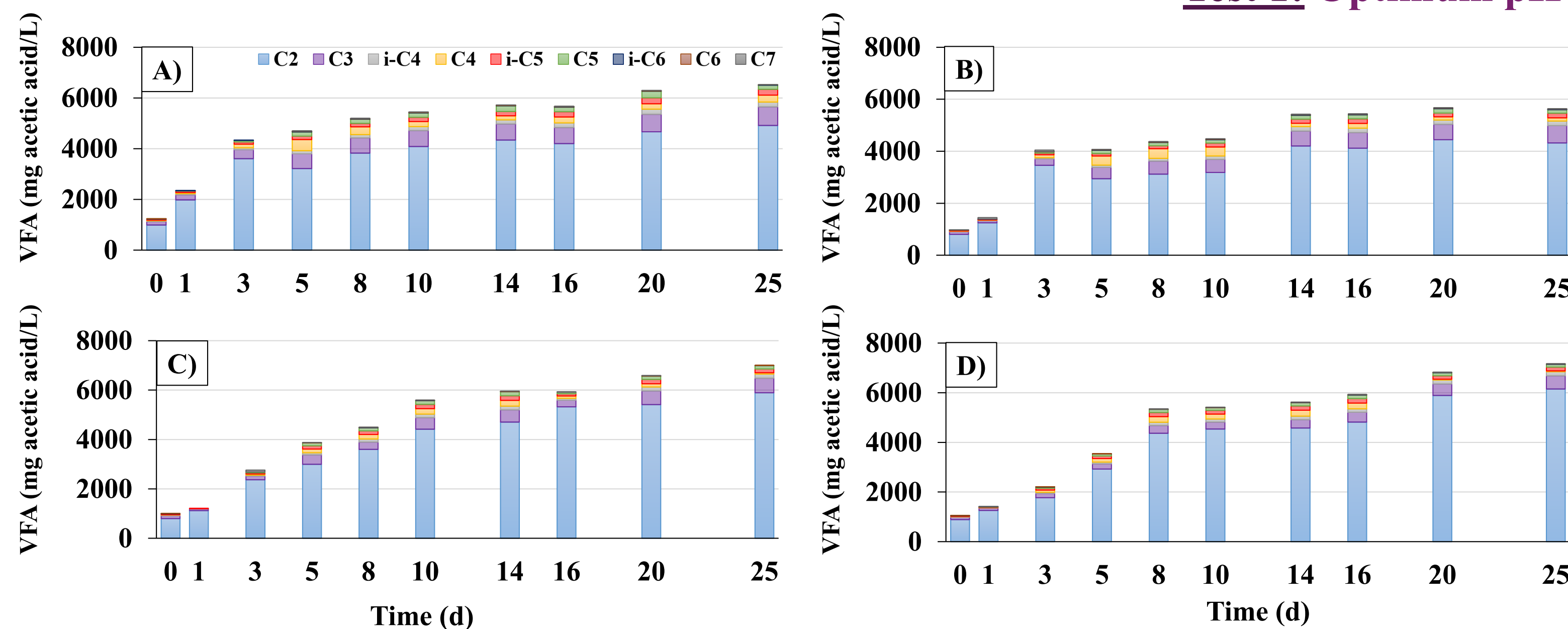


Figure 1. Distribution of VFAs obtained from PW under different pH conditions and filtration levels: PW filtered through 0.5 mm at pH 7.6 (A), and pH 9.0 (B), PW filtrated through 0.45 µm at pH 7.2 (C), and pH 9.0 (D).

PW 0.5 mm

pH 7.2 – VFA = 7.9 g COD/L

pH 9.0 – VFA = 9.1 g COD/L

PW 0.45 µm

pH 7.6 – VFA = 9.6 g COD/L

pH 9.0 – VFA = 9.0 g COD/L

Test 2 and 3: Ethanol, lactic acid, wine lees and cheese whey as electron donors

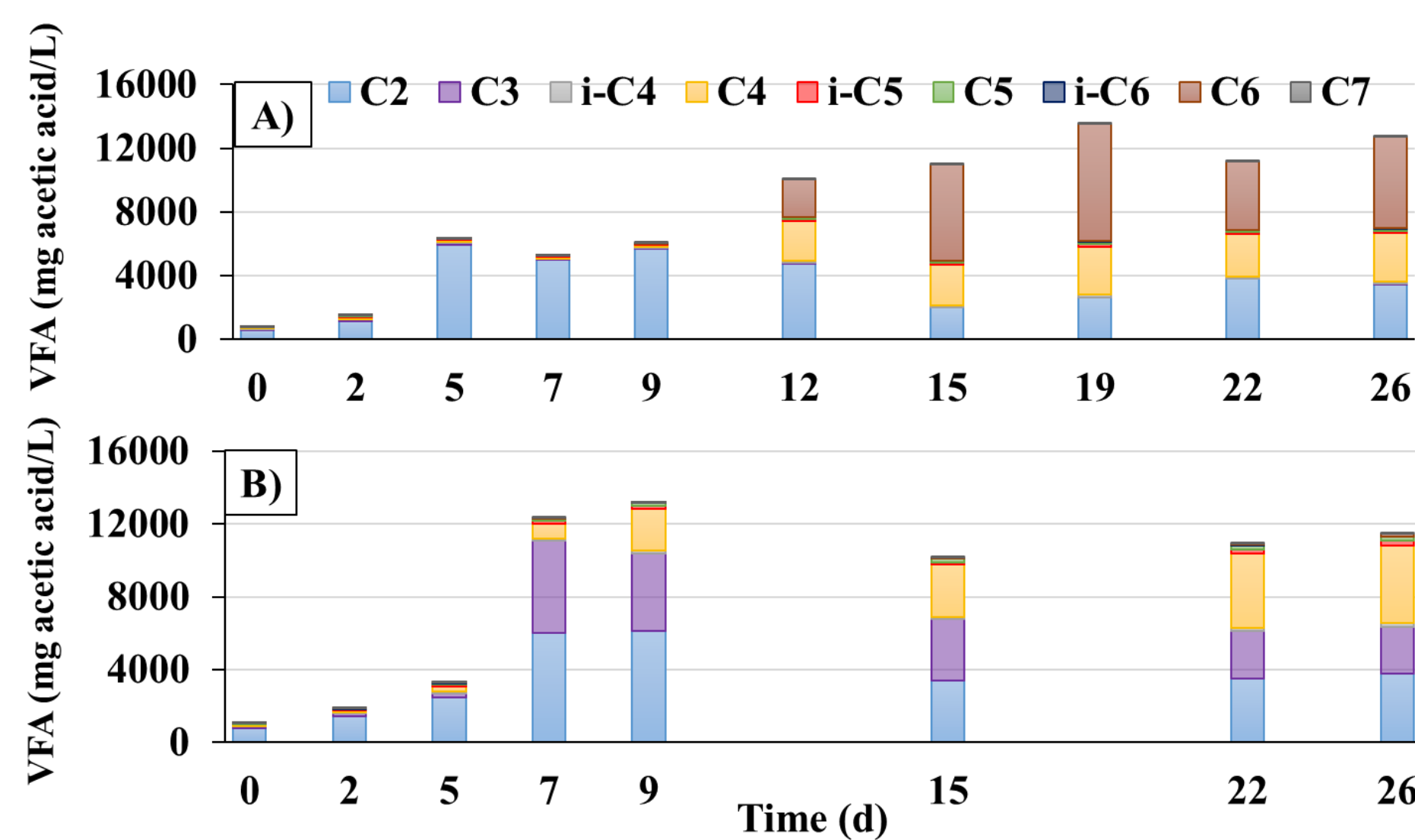
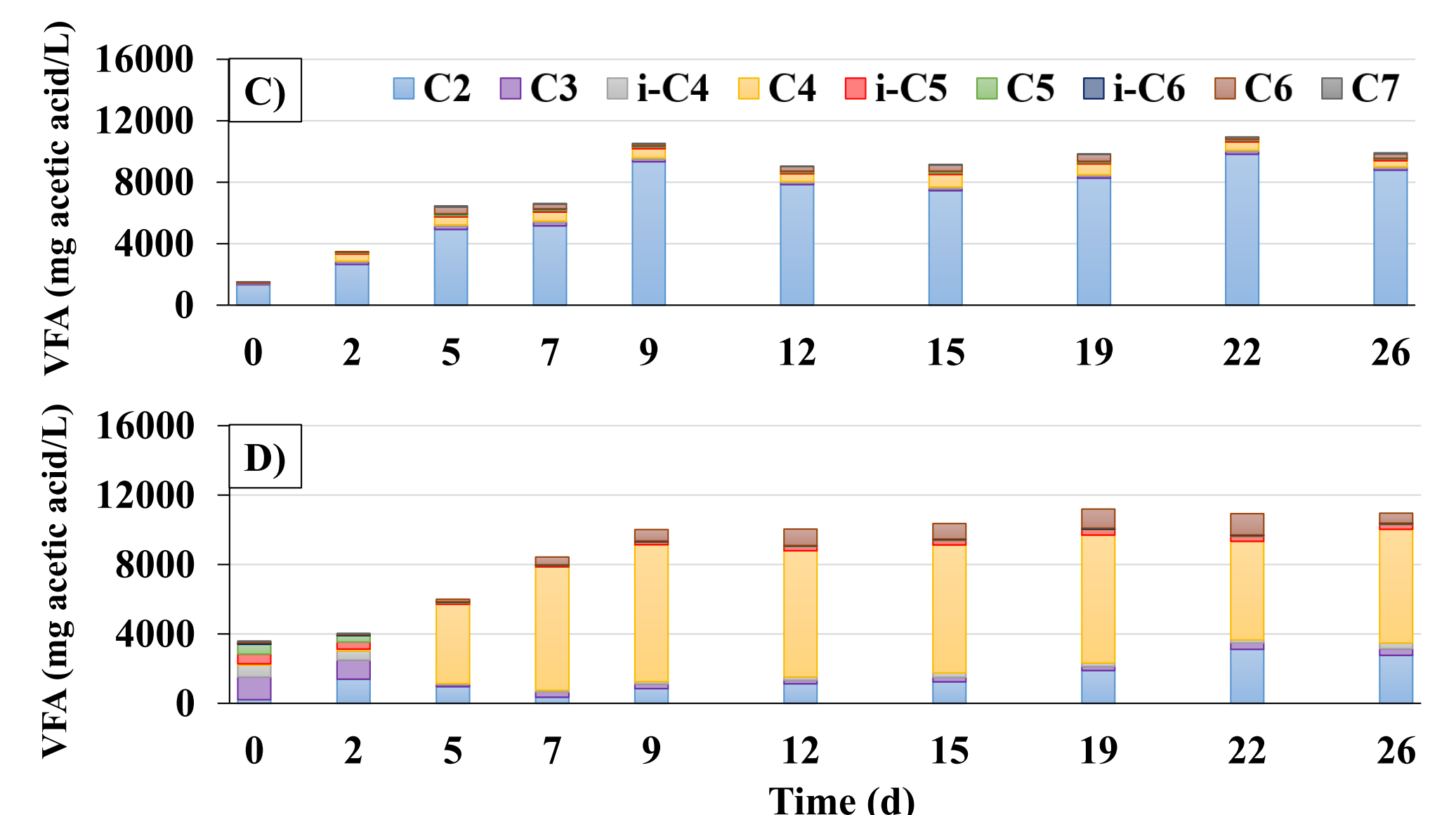


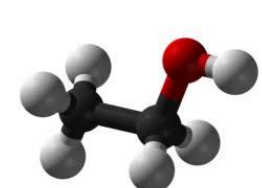
Figure 2. VFA distribution using PW filtered through 0.45 µm and pH 7.6 with the addition of ethanol (15 g/L) (A), lactic acid (15 g/L) (B).

Figure 3. VFA distribution using PW filtered through 0.45 µm and pH 7.6 with the addition of wine lees (C), cheese whey (D).



Conclusions

PW + ETHANOL



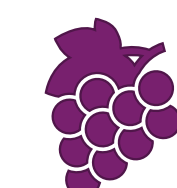
Increase of VFA yield
Elongation to C4 and C6

PW + LACTIC ACID



Increase of VFA yield
Elongation to C3 and C4

PW + WINE LEES



No increase of VFA yield
Mainly composed by C2

PW + CHEESE WHEY



Increase of VFA yield
Elongation to C4

Acknowledgements

The authors greatly appreciate funding from Spanish MCIN/AEI/UE (10.13039/501100011033) through the PID2022-138632OB-I00 project and Madrid Regional Government (Project TEC-2024/BIO-177). L. Martinez-Sanchez acknowledges financial support from the Madrid Regional Government (PIPF-2023/ECO-31000).